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# CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 3 December 1998 with an application for Letters Patent number 333184 made by HANNA HOLDINGS LTD.

Dated 9 February 2000.

Neville Harris
Commissioner of Patents

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333184

Patents Form No. 4

Patents Act 1953

PROVISIONAL SPECIFICATION

# IMPROVEMENTS RELATING TO FIBRE YARN AND ROPE PRODUCTION

We, HANNA HOLDINGS LIMITED, a New Zealand Company of 37 Latimer Square, Christchurch, NEW ZEALAND do hereby declare this invention to be described in the following statement:

## Field of Invention

This invention relates to the production of yarns and ropes, and more particular relates to the production of high or relatively high strength yarns utilising wool or other fibre slubbings or like loosely joined drawn and unspun or partially spun/intertwined fibres and or filaments.

## Background

Conventionally slubbings and like loosely joined lengths of natural and/or synthetic fibres are formed into yarns for weaving, knitting and other purposes by spinning processes and machinery, which can be quite complicated for commercial operations; and the strength of the finished yarn is in most instances determined by the extent or degree of twisting of the fibres into their interlocked form i.e. the tighter the twist, the stronger the finished yarn. However, the tighter twisting also reduces the thickness of the finished yarn and creates a 'hardness' to fabrics woven from or articles knitted with such tight spun yarns; and in the case of natural wool and like fibre yarns and fabrics or articles produced, there is a loss of the desirable springy soft feel and thermal insulation qualities inherent with unspun or partially spun fibre yarns and fabrics/articles produced therewith.

A further problem with typical spun yarns (being a problem that increases with tighter spinning), is that when released from the tension applicable when the yarn is wound into a tight ball or onto a bobbin i.e. on unwinding for use in fabric or article forming, there is the tendency of the yarn to at least partially untwist - which can lead to entanglement and/or difficulties in feed to needles and/or machinery for processing; and in some instances can create a tendency in a finished fabric or article to twist out of the desired finished shape. Similarly fibrous ropes, strings, cords and the like formed with tightly spun fibres in a similar manner to spun yarns can be prone to a partial untwisting tendency and entanglement when released from such as a coil.

## Objects of Invention

An object of the present invention is to provide an unspun fibre yarn or rope having equal or greater strength than many conventional spun fibre yarns and ropes (produced from

similar fibres), and without the inherent tendency to twist or untwist applicable to such conventional spun yarns and ropes.

Another object of the invention is to provide a method and means for producing a relatively high strength yarn or rope utilising predominantly loosely joined drawn or carded fibres in conjunction with longitudinal reinforcing threads and without spinning in the convention manners on conventional yarn spinning machinery, so that the end product yarn or rope retains the fibres in a relatively loose format secured against accidental lateral and longitudinal separation.

Further objects of the invention are to provide a versatile unspun fibre high strength yarn or rope capable of high speed and relatively low cost production in comparison with conventionally spun yarns and ropes, and to provide the method and machinery by which the unspun fibre yarn or rope can be produced.

Other and more particular objects and advantages of the invention will become apparent from the ensuing description.

## Summary of Invention

According to a first aspect of this invention there is provided a yarn or rope comprising a plurality of natural and/or synthetic relatively short and springy fibres or filaments longitudinally loosely intermingled and joined and partially compressed, without being tightly spun, to form a low tensile soft and flexible main yarn or rope body; and at least one relatively high strength natural or synthetic filamentary reinforcing thread longitudinally located and loosely wrapped about said main yarn or rope body in a manner partially loosely confining the fibres against complete separation whilst enabling the fibres to retain their inherent springiness and some freedom of movement relative to adjacent fibres.

According to a second aspect of the invention there is provided a yarn or rope comprising a plurality of natural and/or synthetic relatively short springy fibres or filaments longitudinally loosely intermingled and joined and partially compressed, without being tightly spun, to form a low tensile strength soft and flexible main yarn or rope body; and a relatively high strength natural or synthetic first filamentary reinforcing thread

longitudinally loosely wrapped or wound about said yarn or rope body alternately in short lengths first in one helical direction and secondly in the reverse direction; and a relatively high strength natural or synthetic second filamentary reinforcing thread longitudinally loosely wrapped or wound about said yarn or rope body and said first filamentary reinforcing thread body alternately in short lengths in opposite helical direction to the helical directions of said first filamentary reinforcing thread; the helical wrapping of said first and second filamentary reinforcing threads being in a manner partially loosely confining the fibres of the yarn or rope main body against complete separation whilst enabling the fibres to retain their inherent springiness and some freedom of movement relative to adjacent fibres.

The reinforcing filamentary reinforcing thread or threads according to the immediately preceding two paragraphs can be single filament or multi-filament threads preferably in most instances of a neutral colour for toning with the yarn or rope main body so as to be largely undetectable in a finished product; but a contrasting detectable reinforcing thread or threads can alternatively be employed.

In a another aspect of the invention, the yarn or rope according to the preceding paragraphs further incorporates a longitudinal reinforcing core filamentary thread about which the first and second reinforcing threads are wrapped or wound simultaneously with wrapping or winding about said main yarn or rope body.

In a next aspect of the invention there is provided a method of forming a fibre yarn or rope comprising the provision of a continuous or substantially continuous source of longitudinally loosely intermingled and joined natural or synthetic fibres or slubbings defining a low tensile loose fibre yarn or rope body, and a continuous or substantially continuous source of a filamentary relatively high tensile strength reinforcing thread; drawing said loose fibre rope body through at least one guide and partial compression means and intermittently imparting reverse or opposing twists to alternate sections of the loose fibre rope whilst drawing said reinforcing thread longitudinally into surface contact with said loose fibre rope body at the points of twist and allowing the sections of the loose fibre rope body to engage the adjacent sections of reinforcing thread and cause such sections of reinforcing thread to wrap around said respective loose fibre rope body sections as the rope body and thread move longitudinally, the combined loose fibre rope body and reinforcing thread being further drawn and subjected to compression in achieving the desired yarn or rope finished thickness and being wound onto a receiving

bobbin or like rotating receiver.

In a variant of the method according to the immediately preceding paragraph, a continuous or substantially continuous source of second filamentary thread is separately drawn via guide means into engagement with said loose fibre rope body and first mentioned filamentary reinforcing thread at the exit point of release of twist and reverse twist of the loose fibre rope body and arranged to be wrapped by the first reinforcing thread in longitudinal juxtaposition with the loose fibre rope body as untwisting of rope body and enwrapping first reinforcing thread takes place at said exit point.

The method may further include the feeding together of two or more loose fibre main yarn or rope bodies of different colour and/or characteristics for the obtaining of different appearance and/or texture end product yarn or rope, and products made therefrom.

In a further aspect of this invention there is provided apparatus for the production of an unspun reinforced loose fibre yarn or rope comprising support means mounting at least one partial twist and compression means between which a low tensile strength main rope body of loose intermingled and longitudinally joined natural or synthetic relatively short springy fibres or filaments is arranged to be passed from a supply source via first guide means in juxtaposition with said twist and compression means; drive means for operating said twist and compression means to cause intermittent reverse operation and impart a twist in one direction to longitudinal first sections of said main rope body alternating with longitudinal twist in the opposite direction of second main rope body sections intermediate said first sections; second guide means at said twist and compression means arranged to locate and guide a filamentary reinforcing thread from a supply source into helical wrapping engagement longitudinally about said main rope body as said main rope body passes through said partial twist and compression means; there being driven drawing and compression means for drawing said main rope body and enwrapping filamentary reinforcing thread under tension and from said partial twist and compression means, and for compression of main rope body and enwrapping reinforcing thread in formation of the yarn or rope.

The filamentary reinforcing thread may be introduced before or after the main rope body passes into the or each twist and compression means.

In another embodiment, a plurality of twist and compression means are used, and a separate reinforcing thread is introduced just before the main rope body is drawn into

each successive twist and compression means.

In one preferred aspect of the invention the partial twist and compression means of the aforementioned apparatus comprises a first input endless loop belt and a second output endless loop belt both located in spaced parallel relationship for intermittent reversable movement on respective pairs of pulleys rotatable about transverse parallel axes, there being drive means for moving one loop belt, in the opposite direction to the other loop belt and guide control means for locating and controlling the opposing belt runs of each loop belt so as to be operational in close proximity for gripping of the main rope body passed transversely between the opposing runs of both loop belts, and for gripping of said enwrapping filamentary reinforcing thread between the opposing runs of the output loop belt.

In a next preferred arrangement, the aforementioned apparatus incorporates a third guide means at the output side of the second or output loop belt, and said third guide means is arranged to receive a second filamentary reinforcing thread from a further supply source and direct said second reinforcing thread into longitudinal wrapping engagement about the main rope body and first enwrapping reinforcing thread, as they are all drawn under tension from the partial twist and compression loop belts.

Opposing roller partial twist and compression means may alternatively be substituted for said endless loop belts of the aforementioned apparatus; and driven winding reel or bobbin means can be provided for collection of the formed yarn.

## Brief Description of Drawings

Some preferred aspects of the invention will be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic enlargement of a section of a typical rope of the drawn fibres forming the base main rope body part of the unspun reinforced yarn or rope to be formed;

Figure 2 is a diagrammatic slightly enlarged illustration of a length of the partially formed yarn or rope with a single enwrapping reinforcing thread in accordance with the invention;

Figure 3 is a diagrammatic illustration similar to Figure 2, but with two enwrapping

reinforcing threads in accordance with the invention;

Figure 4 is a plan view diagrammatically illustrating one form of apparatus in accordance with the invention;

Figure 5 is a view in the direction of arrows V-V of figure 4.

Figure 6 is a plan view of a second embodiment of the apparatus of the present invention; and

Figure 7 is a diagrammatic enlargement of a yarn or rope formed by the apparatus of Figure 6..

## Description of Invention

Whilst not confined to such applications, the invention is particularly applicable to and will be described with reference to fibre yarns formed with natural wool fibres, which are renowned for the production of knitting and weaving yarns and have excellent wear, thermal insulation and other desirable qualities; such fibres have an inherent springiness and are readily formed and bonded into yarns (normally by spinning and twisting the fibres all in the one helical direction). Prior to the spinning process the wool fibres are carded and formed in slubbings or long ropes of loosely longitudinally entwined fibres such as that diagrammatically shown in figure 1, and generally indicated by the arrow 1, and such slubbings 1 are employed as the base main confined rope body 1' in the yarns formed in accordance with the present invention.

Contrary to conventional yarn production, in the present invention the wool slubbing 1 is not spun and permanently twisted, but is only subjected to a partial compression and partial twisting and untwisting in short longitudinal sections so that in the finished yarn state the wool fibres of the main rope body 1' remain substantially in their original longitudinally intermingled and joined slubbing state, varied only according to the extent of compression and drawing tension applied by the manufacturing method and apparatus as required for the final wool yarn thickness and intended purpose. The main rope body 1' per se thus has little tensile strength, and the desired higher strength of the finished yarn 2 is provided as shown in the first example of figure 2 by at least one reinforcing thread 3 which is wrapped externally about the main rope body 1' to restrict lateral separation of

the fibres without preventing fibre movement within the general confines of the yarn nominal thickness. The reinforcing thread 3 can be a single filament of a synthetic material, but is preferably formed from a plurality of fine natural or synthetic fibres or filaments of any suitable kind having the desired finished thinness flexibility and tensile strength. As the yarn 2 is not spun in the usual manner, the reinforcing thread 3 is applied by laying alongside the main rope body 1' and twisting/un-twisting (or reverse twisting) short sections of the main rope body 1' of wool fibres. The arrangement allows a significant degree of longitudinal stretching and return to its original size (under the inherent 'clinging' and resilience or 'springiness' of the entwined or entangled wool fibres), whilst deterring longitudinal separation of the fibres and breaking of the finished yarn 2. If required added tensile strength to the yarn 2 can be obtained with the provision of a core reinforcing thread (as indicated in broken line 4) within the slubbing 1 and main rope body 1'; but as a plain core thread 4 would prevent any longitudinal stretching of the finished wool yarn 2, it would be preferable that any such core thread 4 be crimped to allow at least some stretch and return in the finished yarn 2.

With reference to figure 3 of the drawings, for improved lateral confining of the wool fibres against undue separation, and for improved tensile strength without unduly restricting longitudinal stretch and return of the finished yarn 2, two externally applied and wrapped reinforcing threads 3 and 5 are provided; the second external reinforcing thread 5 being applied in counter helical directions to those of the first external reinforcing thread 3 to assist in retention in position of such first thread 3.

Referring now to figures 4 and 5 of the drawings, one form of apparatus for performing the method and producing the yarn 2 of this invention includes support means (not shown) of any suitable kind and construction mounting a pair of similar endless loop belt and pulley arrangements (generally indicated by the arrow 6) which are arranged to impart some initial compression of and partial twist to the main rope body 1' and enable the reinforcing threads 3 and 5 to be twisted and wrapped about the main rope body 1'. The belt and pulley arrangement 6 includes a first input belt 7 (e.g. a Vee section belt) located about a freely rotatable pulley wheel 8 and a driven pulley wheel 9, and a second similar output belt 10 located about a freely rotatable pulley wheel 11 and a driven pulley wheel 12. Pulley wheels 8 and 11 can be on a common horizontal transverse axle 13 (or be separately mounted with a common axis), and the drive pulley wheels 9 and 12 can be located on a common axis 14 parallel with axle 13 and driven by a common power source or main common transmission 15 operated by any suitable power source (not shown) for

intermittent reversable rotating of the drive pulley wheels 9 and 12; but the arrangement includes intermediate transmission means 15a whereby the input belt drive pulley 9 operates in the reverse direction to that of the output belt drive pulley wheel 12, so the upper and lower runs 7a, 7b of the input belt 7 are reciprocally movable in the opposite directions to those of the upper and lower runs 10a, 10b of the output belt 10 for the purpose hereinafter described.

For the single yarn 2 production exampled, the medial portions of the lower belt runs 7b, 10b are raised into close proximity with the respective upper belt runs 7a, 10a such as by location over a pair of spaced freely rotatable intermediate rollers 16; the lower belt runs 7b, 10b passing over a lower support member 17, and there being an upper pressure bar or plate member 18 located in vertically adjustable parallel relationship thereover and above the upper belt runs 7a, 10a to enable an operator to load the apparatus with the required slubbing(s) 1 and reinforcing threads 19 and 20 (two reinforcing threads in this illustration) and make adjustments as required for the slubbing 1 thickness and desired effective belt pressure thereon.

The slubbing 1 and reinforcing threads 19, 20 are supplied to belts 7 and 10 from suitable continuous (or substantially continuous) supply sources, such as rotatably mounted bobbins or reels 1a, 19a and 20a, respectively, of the slubbing 1 and threads 19, 20 - there preferably being any suitable tension and/or reel rotation retarding means to maintain the slubbing 1 and threads 19, 20 under slight tension for smooth operation and unwanted unravelling during operation of the apparatus. The slubbing 1 is fed to the input belt via a first helical or spiral wire guide 21 mounted on the lower support member 17 (the figures 4 and 5 illustrate a further similar helical or spiral wire guide 21' not in use, whereby a second supply of the same or a different colour 1' or any other decorative or reinforcing yarn or thread from a supply source 1'a can be incorporated in the yarn to be produced); first reinforcing thread 19 is supplied to the portion or section of the slubbing 1/main rope body 1' between the two belts 7 and 10 via a loop guide 22 mounted on the support member 17 close to the inner side of the input belt 7; and the second reinforcing thread 20 is supplied to the combined slubbing 1/main rope body 1' via a next loop guide 23 positioned adjacent the output belt 10 at the yarn exit side thereof. A further main loop guide 28 for the slubbing 1/main rope body 1' and enwrapping first reinforcing thread can be provided on the support member 17 medially between the belts 7 and 10.

The yarn components, main rope body 1 and enwrapping (as hereinafter described)

reinforcing threads 19 and 20, are drawn under prescribed (adjustable to suit) tension through and from the partial compressing and twist applying belt arrangement 6 by means of a pair of horizontal parallel axis co-operating compression rollers 24, 25 (via any suitable intermediate guide and/or tensioning means 26 as may be required for direction and/or yarn tension control) which can be driven by an independant power source or the same power source for operation of the belt arrangement 6; and the finished yarn 2 is preferably wound onto a large driven spool, bobbin, reel or like receiving means 27 for commercial use as is, or for subsequent re-distribution in small amounts in ball form or on smaller bobbins as may be required.

In operation of the apparatus (and performance of the yarn manufacturing method) the section of slubbing 1 between the two belts 7 and 10 and adjacently positioned first reinforcing thread 19 are subjected to rapid intermittent reverse twist by the opposing reciprocal directional movement of the upper and lower runs 7a, 7b and 10a, 10b of the respective belts 7 and 10, and by opposing directions of movement of the two belts 7 and 10, with minimal twisting of the longer lengths of the yarn components 1,1', 19 and 20 extending away from the belt arrangement 6. This thus provides that the first reinforcing thread 19 wraps itself helically and fairly lightly about the section of slubbing 1/main rope body 1' drawn between the two belts 7 and 10, alternately first in one direction and then in the opposite direction; and as the combined main rope body 1' and enwrapping first reinforcing thread 19 continue through and exit from the output belt 10, the almost immediate untwisting of the combination (with the inherent resilience and springiness of the wool fibres) causes the second reinforcing thread 20 supplied to the exit and untwist point to wrap around the main rope body 1' and first reinforcing thread in longer pitch helical sections counter to the helical directions of the first reinforcing thread 19, to restrict unravelling of the latter.

Whilst the illustrated and described apparatus provides for the manufacture of a single yarn, it will be appreciated that a number of the yarns can be simultaneously produced on the one twin belt arrangement 6 with duplication of the yarn component partial compression and twist points, with the associated similar guides 21, 22 and 23, at spaced intervals along the length of the section of the belt runs 7a, 7b and 10a, 10b located in close proximity. A common support member 17 or separate support members 17 can be provided below the lower belt runs 7b and 10b for the respective points of twist and guides 21, 22 and 23, but preferably individual upper adjustable pressure members 18 are provided. Separate sources of supply 1a, 19a and 20a of the wool slubbings 1 and

reinforcing threads 19 and 20 will then be provided for the respective yarns 2 to be formed.

In a modification of the invention the upper adjustable pressure members 18 can be dispensed with an replaced by rotatable cam members which intermittently bear on the upper surface of the upper belt runs 7a and 10a to urge such upper belt runs 7a and 10a into engagement with the slubbings 1 or main rope bodies.

A second embodiment of the invention is shown in Fig. 6. In this embodiment, the general layout and operation of the apparatus are similar to Fig.s 4 and 5 except as specifically described below.

As shown in Fig. 6, the apparatus comprises a series of four parallel belts 30-33 inclusive, each driven between opposed pairs of drive pulleys (not shown) by any suitable drive means.

The first belt 30, is driven continuously in the direction of arrow A and is used to impart a first twist to a slubbing, as hereinafter described. The remaining three belts, 31-33 are reciprocated in the directions of arrows B/C, with all three belts 31-33 moving in the same direction at the same time.

Over the central portions of the runs of the belts 30-33, the upper and lower runs of the belts are pressed together by a pre-set amount, using any suitable means (not shown) e.g. a raised table underneath the lower run of the belt.

Three spaced parallel sets of loop guides 34-41 are arranged on each side of each belt 30-33, to guide a slubbing 1 as it passes through the belts.

In operation, a slubbing 1 is drawn through the apparatus in the direction of arrows 5, as described with reference to Fig. 4 and 5. The slubbing passes through the loop guides 34-41. As the slubbing 1 passes through the belt 30, the friction between the belt and the slubbing imparts a twist to the slubbing, to give the slubbing some initial compression and cohesion. Most of this twist is lost as the slubbing progresses through the remainder of the apparatus.

At each of the remaining belts 31-33, the slubbing passes between the opposed runs of the reciprocating belts, so that the slubbing has one section twisted one way, then the next section twisted the other way as the slubbing moves relative to the reciprocating

belts. All of this twisting produces a series of false twists in opposite directions along the length of the slubbing. As the slubbing leaves each belt, its natural resilience opposes the false twist imparted by the belt, and the slubbing starts to untwist. Reinforcing threads 42, 43, 44 are fed through loop guides 36, 38, 40 respectively, adjacent the intake sides of each of the belts 31-33. Thus, the corresponding reinforcing thread lies adjacent the slubbing and is wrapped around the slubbing as the false twist is imparted by the corresponding belt, and is then wrapped still further as the slubbing starts to untwist after leaving the belt.

The finished product emerging from the apparatus is shown in Fig. 7 - the slubbing 1 is wrapped in the three reinforcing threads 42, 43, 44.

Although three false-twist belts 31-33 are shown, it will be appreciated that only a single such belt may be used, or additional false-twist belts may be added. Similarly, only a single reinforcing thread may be used, or any number of such threads, depending upon the required characteristics of the end product.

Up to three slubbings may be run through the apparatus at once, one for each set of loop guides 34-41. However, wider apparatus can be used to process more than three slubbings simultaneously.

The initial twist belt 30 may be omitted, depending upon the initial strength of the slubbing.

As spinning of the yarn does not take place, the apparatus or machinery required for production of the yarn in accordance with the invention is not as complicated as conventional yarn producing apparatus and significantly faster yarn production is possible; thus enabling considerable costs savings in production as well as providing a yarn having the anti twist finished structure and the other previously mentioned advantages of flexibility, softer feel and retention or maximising of the inherent wool fibre springiness and thermal insulation qualities.

The invention has been particularly described with reference to the production of wool fibre based yarns for knitting and weaving into articles, but it will be apparent that a considerable variety of types and thickness of yarns can be produced for various purposes, including tufted and looped carpet manufacture; and that the invention is similarly applicable to the economic manufacture of ropes and cords of various kinds.

The yarns ropes and cords etc can be produced utilising a variety of fibres and fibre mixes, including crimped synthetic fibres or filaments for the main loose fibre rope body and the stronger thinner reinforcing threads.

Some preferred aspects of the invention have been described by way of example and many other variations of and modifications to the invention can take place without departing therefrom.

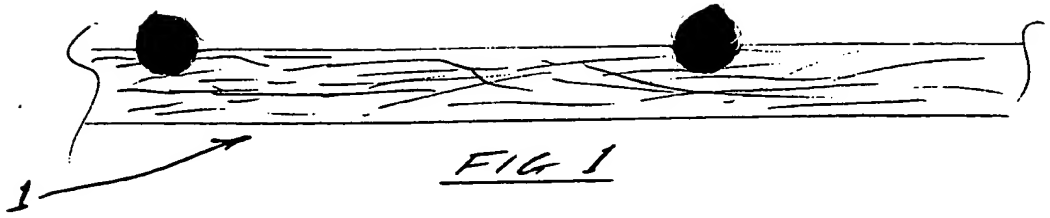


FIG 1

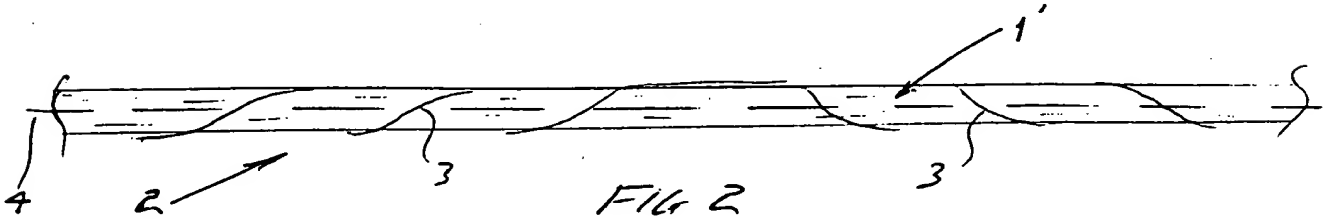


FIG 2

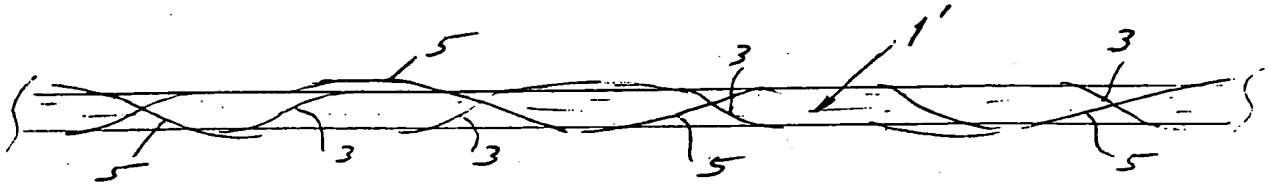


FIG 3

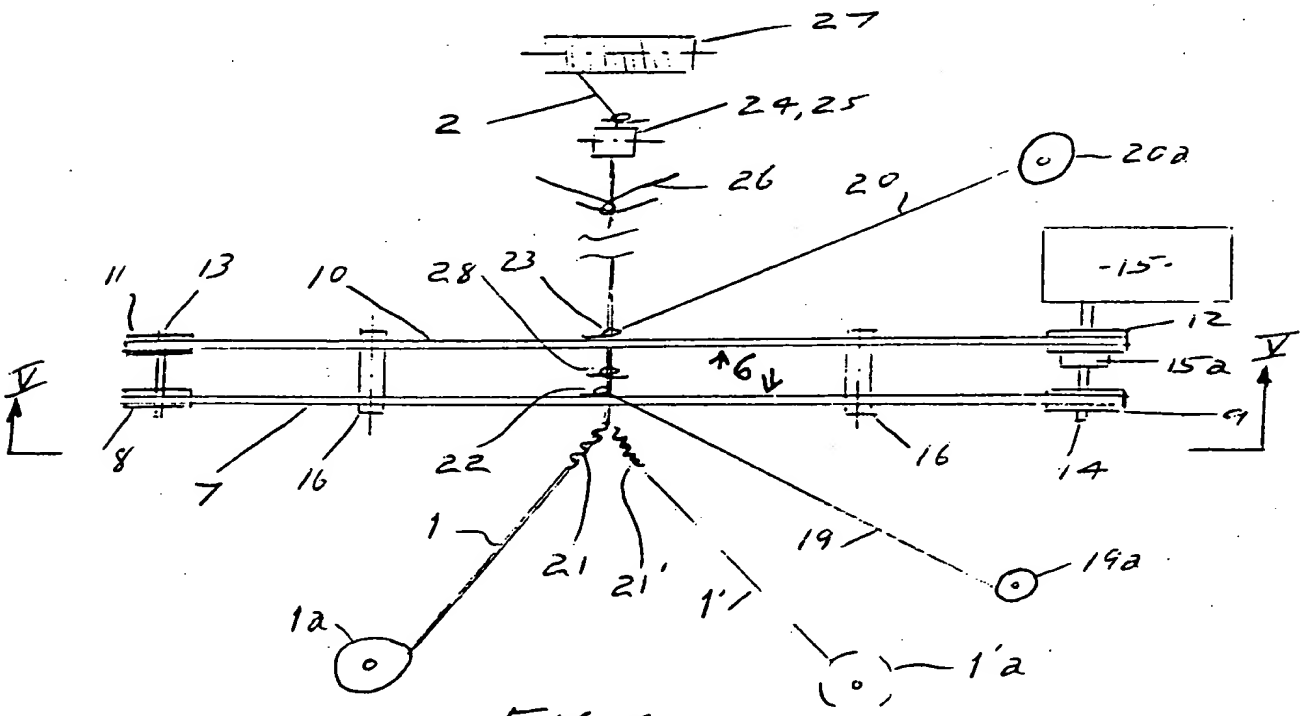


FIG 4

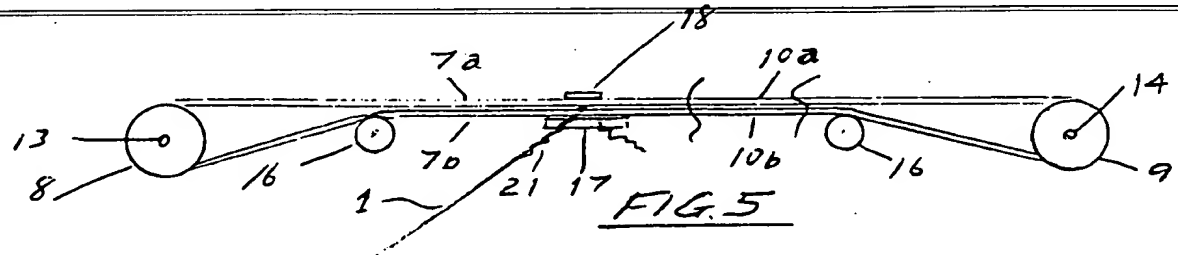


FIG 5

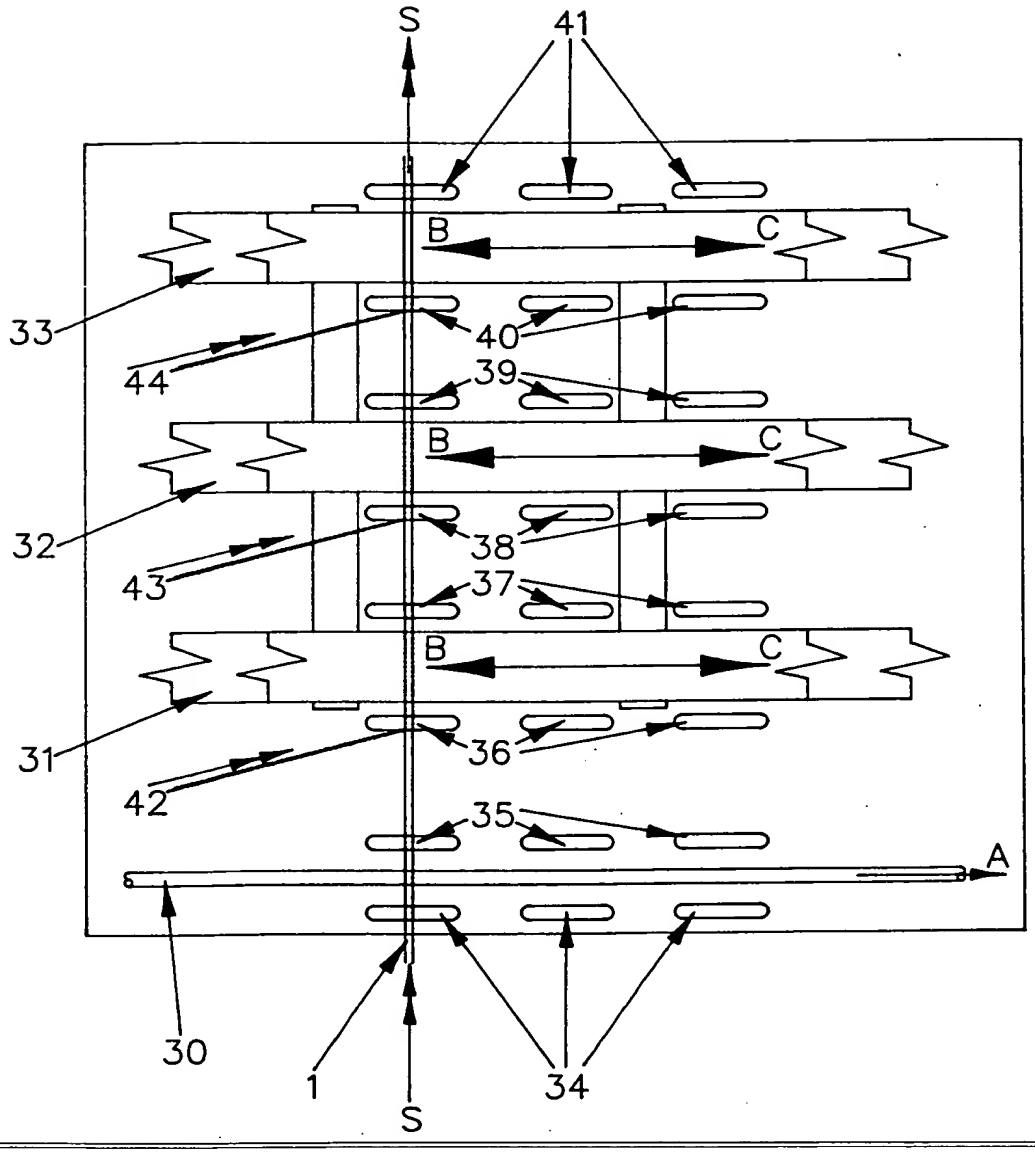


Fig.6.

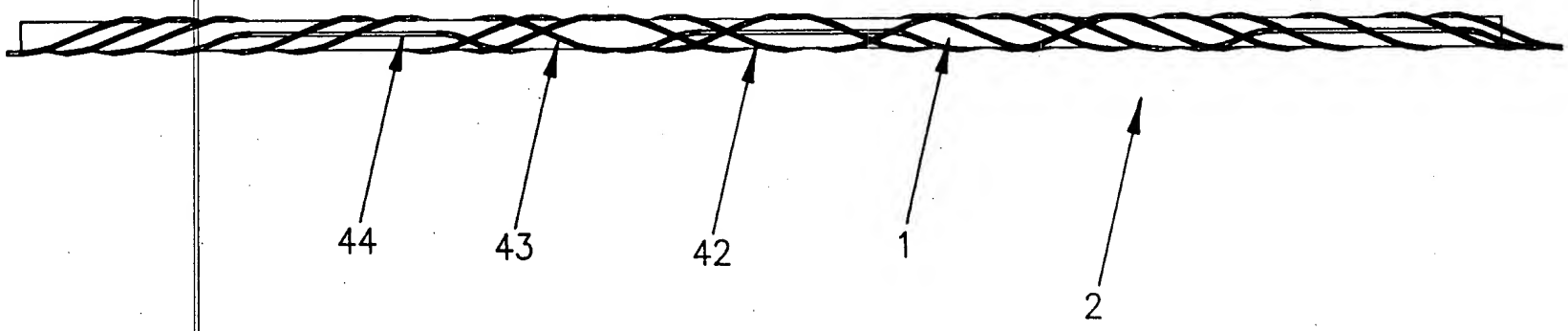


Fig. 7.